DOCUMENT RESUME

ED 094 949 SE 016 113

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TITLE An Analysis of the Relationship of Individualized Instruction, Self-Image of Achievement and Achievement in High School Biology.
PUB DATE Mar 73
NOTE 12p.; Paper presented at the annual meeting of the National Association for Research in Science Teaching (46th, Detroit, Michigan, March 1973)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Academic Achievement; *Biology; *Educational Research; *Individualized Instruction; Science Education; Secondary School Science; Secondary School Students; *Self Concept
IDENTIFIERS Research Reports

ABSTRACT

Reported is an investigation designed to show the relationship between the time required by a student to achieve and his self-image of achievement. Approximately equal numbers of 10th- and 11th-grade biology students (N=57) from two intact classrooms were involved in the study. Learning materials from the Biological Sciences Curriculum Study (BSCS) Green Version High School Biology (1963) were adapted to self-paced instruction. Students in both groups were given several guiding questions to be answered. For one group, teacher-specified activities were provided to help answer the questions. For the other, referred to as student structured experiences (SSE), students were asked to develop their own activities to provide the answers. The Q-sort of Single Adjectives, used to measure self-image of achievement, was administered at the beginning of the experiment and after 43, 98, and 120 days of classroom activity. Achievement was measured both by the BSCS Quarterly Tests One and Two and by the BSCS Comprehensive Final Examination. The investigator concluded that independence of learning required gradual development by most students. The academic performance of the teacher-structured group was superior to that of the SSE group but some SSE students were able to develop independent learning behavior as evidenced by superior achievement scores. (PEB)

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An Analysis of the Relationship of Individualized Instruction, Self-image of Achievement and Achievement in High School Biology*

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Carroll (1963) developed a mastery learning model in which time is used to measure aptitude. Bloom added to the model, stating that the complexity of a task is not a limiting factor in learning provided the learner is given adequate time and appropriate help (Block, 1971). Bloom indicates that a basic problem of mastery learning is finding ways to reduce the learning time for slower students. In this study the amount of freedom given the student in determining how he would learn a particular biological concept was varied to find its effect upon learning time and achievement.

Self-paced instruction which allows the student time to achieve is adaptable to the mastery learning model. The research of Hounshell and West (1970) shows that individualized instruction gives the student a greater opportunity for success in school and results in a positive change in the individuals self-image. Purkey (1970) believes that a positive relationship exists between poor academic achievement and negative self-image of achievement. This investigation attempted to show the relationship between the time required by a student to achieve and his self-image of achievement, since learning time has replaced the degree of subject matter mastery as the measure of aptitude.

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*Paper presented at the National Association for Research in Science Teaching (NARST) Annual Meeting, Detroit, March, 1973.

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PROCEDURE

Approximately equal numbers of 10th and 11th grade biology students (n=57) from two intact classrooms were used in the study. Since the course was an elective, the sample may not have been representative of the school population, but the two groups were found to be homogeneous when compared by IQ, Iowa Test of Educational Development, self-image and achievement pretest scores.

Learning materials from the BSCS Green Version High School Biology (1963) were adapted to self-paced instruction. Major biological concepts were identified by the investigator and specific problems or questions related to each concept were written for the investigation. The students in both groups were given several guiding questions to be answered. The questions were presented to the two groups in two ways. For one class, activities specified by the teacher (teacher structured experiences group) were supplied to help answer the questions. The other class was given the same questions, but was not supplied specific activities with which to answer the questions (student structured experiences group). They were asked to develop their own activities to provide the answers.

The concept of biome can be used as an example of how the questions and activities were used for the two groups. To understand the concept of biome, the student must know the cause of world climates as well as the relationship between living organisms, precipitation, and temperature. To develop an understanding of climates, the students of both groups were given specific questions

related to the physics of air. Typical questions were, "What happens to the ability of air to hold water as it cools?" or "What happens to the temperature of air when compressed?" The activity specified by the teacher for the teacher structured experiences group (TSE) asked the students to measure the relative humidity of the outdoor air with a humidaguide. They then collected a coffee can of the cooler outdoor air, placed the humidaguide inside the can, covered it, and warmed it to room temperature. After the air had warmed they again measured the relative humidity. In addition to the laboratory exercises they were supplied with reading material on trade wind patterns and causes. The concept test was a single question, "Why is the Sahara Desert a desert?" To answer the question the student had to understand the cyclic flow of trade winds, reason for convection currents, relationship of air compression to temperature and relative humidity, and cause of seasonal change on the earth. If the student in the TSE group satisfactorily answered the question, he was allowed to work on questions leading toward understanding of a new concept. If he did not, the discrepancy was analyzed and specific exercises were given.

The student structured experiences group (SSE) developed their own experiences providing data to answer the questions. Some students for instance, collected air in a plastic bag at room temperature and placed strips of dry cobolt chloride paper into it. They noted color change in the paper strips after placing the bag of air into the refrigerator. SSE students failing the concept test were only given new questions that indicated the learning areas in which they needed more experience.

Other concepts were studied similarly. Laboratory exercises, readings, film loops, 16 mm motion pictures, recording, and field trips were used by the TSE group, and were available for use by the SSE group.

Whether the teacher structured the learning experiences or the student structured the learning experiences, was the independent variable. Its effect upon the time required to gain concept competency, student self-image of academic achievement, and academic achievement was measured.

The time factor was the number of class days needed to pass the concept test for each student. Since the number of concept tests passed varied, the mean of the time needed to pass the concept tests was also used. The effect of the independent variable upon the time factor was measured by the t test.

The Q sort of Single Adjectives (Humphreys, 1972) used to measure self-image of achievement, was developed and tested for reliability by the investigator in a pilot study. It consists of fifty IBM data processing cards, each with a positive (capable, aware, successful) or negative (unsatisfactory, dishonest, failure) adjectives. The adjectives had weighted values of from one to five for both the positive and negative terms. The cards were sorted so that the terms which best discribed how they perceived their academic achievement were on the top of the card deck and those terms least discriptive were on the bottom. The ideal sort produced a score of 100. The Q sort was administered at the beginning of the experiment and after 43, 98, and 120 days of classroom

activity. The effect of the structuring of learning activities upon the self-image of academic achievement was tested by analysis of variance with repeated measures (Winer, 1962).

Achievement was measured both by the BSCS Quarterly Tests One and Two and by the BSCS Comprehensive Final Examination. The effect of teacher structuring of learning experiences was measured by the t test.

The experiment was conducted during the first three quarters (120 class days) of the 1971-72 academic year.

ANALYSIS AND RESULTS

The learning rate data are shown in Table 1. The two classes differed significantly, with the TSE group developing an understanding more rapidly on the initial concepts of the study. The learning rates equalized after the early concepts tests, but the initial difference was sufficient to show statistical significance at the conclusion of the study.

Concept achievement measured by the BSCS Quarterly Tests (Table 2) shows no significant differences between the two groups. Since a significant difference did exist between the groups when considering the rate of learning, the quarterly test data indicate that the concepts were retained equally in both groups regardless of when they were learned. Achievement scores from the BSCS Comprehensive Final (Table 3) show a significant difference favoring the TSE group. The difference between the two tests lies in the number of concepts learned. The final examination measured concepts not learned in addition to those learned. Since

TABLE 1

Analysis of Concept Achievement Rate

SSE Group		TSE Group		σ^2	t
N	$\bar{X}$	N	$\bar{X}$		
	Days Per Concept		Days Per Concept		
29	23.22	28	18.61	29.13	3.22*

*Significant at the 0.01 level.

Critical t = 2.05 at the .05 level of significance.

TABLE 2

Achievement on BSCS Quarterly Tests 1 and 2

	SSE Group		TSE Group		σ^2	t
	N	$\bar{X}$	N	$\bar{X}$		
Test One	29	22.00	28	21.00	26.44	0.73
Test Two	29	18.69	29	19.14	21.56	0.36

Critical t = 2.05 at the .05 level of significance.

TABLE 3

Achievement On BSCS Comprehensive Final, Form K

Student Structured Experience Group		Teacher Structured Experience Group		σ^2	t
N	$\bar{X}$	N	$\bar{X}$		
29	19.69	28	22.57	19.98	2.44*

*Significant at the 0.01 level.

Critical t = 2.05 at the .05 level of significance.

the TSE group studied more concepts during the 120 days of the study, this was reflected in their significantly higher scores.

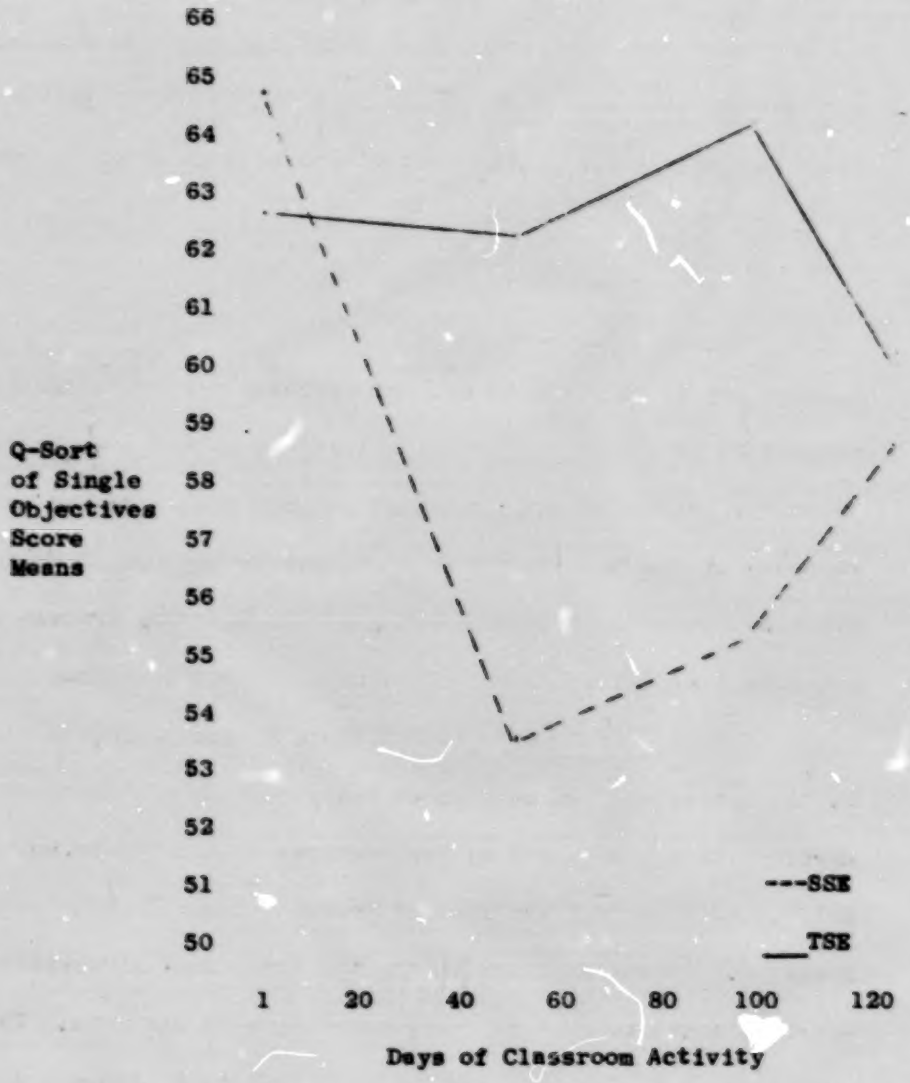
The self-image data are shown in Figure 1. No significance was shown between the groups when the study began or when it concluded. Significant differences in self-image did exist between the groups for tests after 43 and 98 days of classroom activity.

DISCUSSION

It may be an ultimate goal of learning for the individual student to be independent. The ability to solve problems and learn new principles requires that an individual gain an understanding of the learning process so that he may use it as a tool. For many students an understanding of the learning process has not been fostered by previous learning experiences since only low level learning, in Gagne's (1970) hierarchical scale, is required by their teachers. When concept understanding and principle development are required by the teachers within the framework of self-paced learning, the idea of learning independence becomes feasible. It was apparent during the study that independence of learning required gradual development by most students. The TSE group was initially superior in their ability to achieve academically and required significantly less time to pass the individual concept tests. They maintained a relatively stable self-image of achievement while the self-image for the SSE group fluctuated significantly. Late in the study, the students of both groups were similar in the time required to pass concept tests and in their

FIGURE 1

Self-image of Academic Achievement

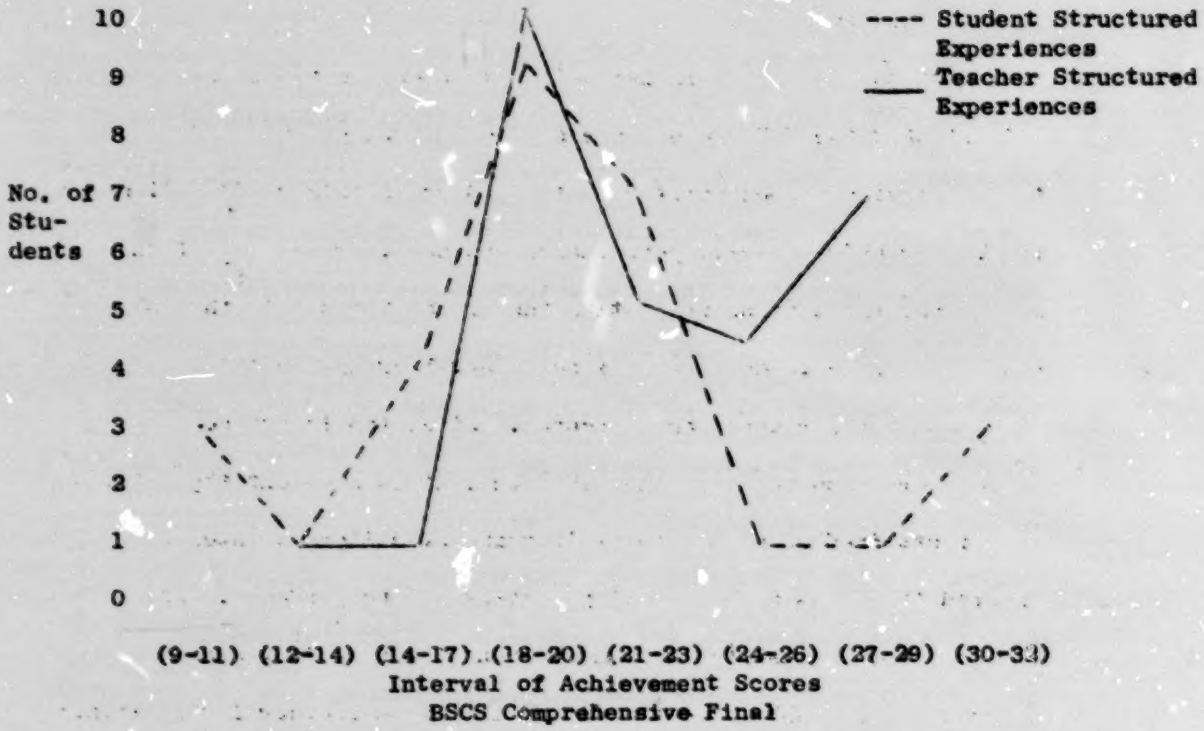


self-image of achievement. Changes in learning experiences initially were observed to be somewhat frustrating for the students of both classes, but particularly when the independence of learning was emphasized.

When comparing the individual achievement scores it became evident that the TSE scores have a more central grouping, while the greatest extremes existed in the SSE group (Figure 2). Although the TSE group's academic performance was superior to that of the SSE group, there is an indication that some students in the SSE group were able to develop an independent learning behavior, shown by superior achievement scores. Since the lowest achievement scores were also found in the SSE group, it is apparent that students either attained independence of learning at different rates or entered the class with differing degrees of independence. The students not well suited for independent learning in the SSE group could probably have benefitted more from another instructional method giving a higher degree of structure to their learning experiences.

FIGURE 2

Distribution of Achievement Scores



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